Changing Currents in Environmental Analysis

How Global Climate Change Issues are Impacting the Need for Specialization and New Approaches in Ambient and Emission-specific Analysis

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Conventional models, particularly for air analysis at industrial and community sites, have traditionally been based upon meeting standards and sustaining compliance with regulations set by state and federal agencies. This focus has driven the selection of procedures and schedules for a wide variety of testing, following well-established standard methods. In the majority of situations, sampling and testing has focused upon the determination of emissions and contaminants within a particular stream of physical media that is part of an isolated manufacturing or distribution process. Alternatively, the general ambient environment surrounding a particular plant or other location of specific interest due to extraction, transport, industrial processing, storage, or consumption has been the target for emission sampling and monitoring. Historically, there has been little consideration for how multiple systems, including those of manmade origin, react with one another (for example, outside urban and industrial zones, and in newly developing economic regions such as China with significant eco-cultural differences). There has also been little consideration until quite recently about how diverse production systems can collectively be employed to support measures that will enhance positively the impacts of a highly industrialized and energy-rich society upon the ecosystem. As two examples, there is biomass waste from agricultural products used in ethanol production, and pyrolisis processing of rubber and plastic waste, both producing a variety of synthetic gases. These bring in beyond the usual emission concerns the positive prospects of electric power generation through use of what is otherwise a byproduct.

The impact of the global climate change crisis upon society and industry, like the very issue of what is or is not ongoing and predictable within regional and global climate patterns, is characterized by interdependency and uncertainty. While specific trends and consequences may still be unclear and unpredictable, and even more so for specific causes, the rise in aggregate emissions, especially of types contributing to CO_2 releases and upper-atmosphere ozone depletion, are indisputable. Likewise there is the evident higher-impact effect from virtually any non-linear climate events (floods, droughts, storms) upon increasingly dense population centers.

The ability of society, from the level of corporate plants and small residential communities up to the scale of states and nations, to move rapidly, efficiently and economically in response to non-linear atmospheric and terrestrial environment shifts, as well as the ability to support a broad-based plan of attack for the reduction of CO_2 through lower emissions and higher retention and storage, is dependent upon having a different kind of knowledge about the states and trends of emissions going into the airstreams and waterstreams. Heretofore the focus has been upon tracking levels of compounds and even predicting future levels – but of individual types, not considering much about long-term build-ups, reactions, or positive re-uses. What is desirable and necessary now is an ability to build accurate and dynamic network models of environmentally significant emission concentrations and interactions, not only for the well-understood toxic compounds but for many that can be useful in regional and global management of air, water and land resources.

Such a network model is not entirely dissimilar from network models employed in power distribution, traffic control, and telecommunication systems. What has been missing, for the most part, has been sufficient and broad data flow with highly accurate analysis of chemical compounds in the manner by which these analyses have been conducted to date for high-risk or high-emission producers such as petroleum, chemical, electronics, and heavy equipment plants. The established methods are there for the detailed field and lab chemistry. The network paradigms and mathematics exist for integrating large data sets into cohesive predictive models. The economics of synergy to find better ways to clean, re-use and recycle that will proactively counter global climate change effects, particularly with respect to the carbon cycle, may be simpler than initially imagined, if a more complete and detailed map of chemical processes and contents in our atmosphere and waterways can be made instead of being forced to work with low-res vision.

The realistic technology to implement a practical new generation of environmental analysis "en masse" has only emerged within the past five years. It involves a confluence of micro and small-scale, low-cost sensors, reduced costs for detailed formal lab analysis, and massive, ubiquitous, all-purpose communications including wireless and remote sensing. It is practical for a vast number of businesses and organizations to be analyzing and monitoring all facets of what goes in and what comes out of their buildings and operations, starting with the most important streams of air and water. What has been ongoing for years now at major oil refineries and plastics plants can and should now be ongoing in virtually all major consumers and transformers of energy, as well as in virtually all major public thoroughfares and concentrations of large populations. The assessment of such large data streams is computationally a fait accompli by virtue of applying inverse methods, large-scale nonlinear thermodynamical statistics and other modeling techniques. What specific energy and climate benefits will emerge is not any more clear today than the specific issues and threats we face over the next two, five, or one hundred years, but we can safely assume that there will be far more benefit to pursuing this type of course of action than to avoid doing so. If it is a process that can change the air or water in composition or temperature, then we need to monitor and understand those dynamics and determine how those changes can be used to balance or counterbalance something else in our ecosystem in order to stabilize and gain better control over what could otherwise rapidly become a world quite out of control for living beings.